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ABSTRACT

Price analysis was used to determine if the behavior of weekly carrot prices at shipping points and wholesale terminal markets is generally consistent with a competitive marketing system. The marketing system for fresh winter carrots in 1966-68 performed efficiently in establishing prices that cleared the supply of perishable produce each day and week of the marketing season. Prices at all locations in the marketing system were closely correlated, separated by transportation, storage, and handling costs. Margins were related to the distance transported and the price of the commodity. Shipping-point prices were inversely related to the supply of carrots available. Price estimates were significantly improved by adding proxy variables--temperature and rainfall during production and harvest--to reflect the quality and size distribution of carrots marketed. Wholesale terminal market prices directly responded to shifts in shipping-point prices.

Key Words: Vegetables, Carrots, Market, Pricing performance, Price analysis, Marketing system, Margins, Shipping point, Wholesale terminal markets.

PREFACE

This report is the second of a three-part series examining pricing performance and efficiency of the marketing system for fresh winter vegetables. Pricing Performance in Marketing Fresh Winter Lettuce, Mktg. Res. Rpt. No. 956, Economic Research Service, U.S. Department of Agriculture, was published May 1972. The third report describing the marketing and pricing of winter tomatoes is scheduled for early release.

These publications are based on a research project entitled "An Equilibrium Analysis of the Production, Distribution, and Marketing of Winter Vegetables." The project was a cooperative effort between the North Carolina Agricultural Experiment Station, represented by Richard A. King, Department of Economics, North Carolina State University at Raleigh, and the Economic Research Service, USDA.

The Federal-State Market News Service and the Consumer and Marketing Service, USDA, were the primary sources of data for these publications.

CONTENTS

	Page
Summary	iv
Introduction	1
The Winter Carrot Industry	3
Price Structure	6
Comparison of Costs and Margins	9
Relationship of Wholesale Terminal Market and Shipping-Point Prices	18
Current Prices	19
Price Prediction	22
Price Prediction at Shipping Point	24
List of References	30
Appendix	31

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SUMMARY

The marketing system for fresh winter carrots performs efficiently in establishing prices that clear the available supply daily during the season. Weekly price changes for fresh winter carrots at shipping points and at 10 wholesale terminal markets were analyzed for the winters of 1966-68. Prices of carrots were lowest at shipping points, increasing with distance and time to wholesale terminal markets. For example, average prices of carrots increased from $3.72 in the Lower Rio Grande Valley of Texas to $4.62 in Chicago and $4.73 in New York. (Carrots are generally packed in mesh or similar type sacks holding 48 1-pound polyethylene bags; hence, prices are usually quoted for 48-1's mesh.)

Price differentials or margins between the shipping point and the wholesale terminal market were found to be consistent with marketing costs--transportation, handling, storage, and risktaking in moving produce through space and time. Margins varied with the distance transported and the price of the commodity.

At all locations in the marketing system, prices of winter carrots were closely correlated. The correlation between the price of Texas carrots in the Lower Rio Grande Valley, for example, and the San Francisco price of California carrots was nearly perfect at 0.97, although Texas does not normally ship winter carrots to San Francisco.

Based on the physical flow of produce and knowledge of buying practices, shipping points were identified as the focal point in the marketing system where carrot prices first change. Wholesale terminal market prices directly respond to shifts in shipping-point prices. In New York, the price of Texas carrots could be predicted by adding $0.87 to 1.03 times the shipping-point price in the Lower Rio Grande Valley. Similar relationships held for most other wholesale terminal markets.

Weekly shipping-point prices were inversely related to the supply of carrots available. In addition, price estimates were significantly improved by adding proxy variables to reflect the distribution of quality and size of carrots. Eighty-eight percent of the variation in the price of Lower Rio Grande Valley carrots, 48-1's mesh, was explained by Texas shipments, California shipments, average high temperatures at Weslaco, Tex., the previous 2 weeks, and the deviation from normal rainfall in the Lower Rio Grande Valley the previous September.

A few areas were observed where possible "poor" performance was indicated and adjustments in institutions and market information systems may be in order. For example, margins for Texas carrots were high in Detroit relative to other wholesale terminal markets. Also, in the winters of 1966 and 1967, residual margins for Texas carrots in some cities appeared to be inversely related to Texas' share of carrot unloads.

PRICING PERFORMANCE IN MARKETING FRESH WINTER CARROTS

by

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INTRODUCTION

This report focuses on the shortrun weekly behavior of winter carrot prices at shipping points and wholesale terminal markets. Because marketing channels in this important industry have been changing in recent years, growers, shippers, wholesalers, retail organizations, and others concerned with the carrot industry are especially interested in how prices are established and, in turn, how they are reflected throughout the marketing system.

Over time, major adjustments in the marketing of fresh carrots have occurred, including a shift toward increased direct buying on the part of large retail organizations and a reduction in the number of ownership transfers between shipping points and retail outlets. Consequently, the price-making function has tended to move from the wholesale terminal market to the point of production.

Carrot prices often fluctuate widely over relatively short periods of time. For example, for the week ending January 20, 1967, Texas carrots were priced at $2.60 in the Lower Rio Grande Valley of Texas, $3.50 in Chicago, and $3.75 in New York. 1/ For the same week in 1968, Texas carrot prices in the Lower Rio Grande Valley were $7.81, or 200 percent higher; in Chicago and New York, prices per mesh sack of 48-1's were $8.90 and $9.75, respectively.

Theoretically, carrot prices are established through the interaction of demand, derived from the retail demand for carrots by consumers and the supply of carrots available. Under competitive conditions, prices of carrots at shipping points and at wholesale terminal markets will differ by no more than marketing costs; that is, transportation, storage, and handling costs (3). 2/

With a shift in carrot prices at the shipping point or at the wholesale terminal market, prices at all other locations in the marketing system should vary accordingly. For example, a change in the price of carrots in the Lower Rio Grande Valley of Texas should be reflected by shifts in wholesale terminal

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1/ Winter carrots generally are packed in mesh or similar type sacks holding 48 1-pound polyethylene (film) bags.

2/ Underscored numbers in parentheses refer to items in the List of References.

market prices of Texas carrots in New York, and California carrots in San Francisco and the Imperial Valley of California. In practice, it may take several hours for buyers and sellers to become aware of price changes and several days for fresh supplies to move from point of production to point of consumption. In addition, if shifts in shipping-point prices are imperfectly relayed to wholesale terminal markets, prices at different locations may not adjust (or only partially adjust) and thus get out of line with marketing costs.

To evaluate whether shortrun changes in carrot prices were consistent with a competitive marketing system, it was necessary to determine:

(1) The price structure of the carrot market as measured by the level of shipping-point and wholesale terminal market prices;

(2) The relationship of observed price differences between the shipping point and the wholesale terminal market and actual costs of transporting, handling, and storing carrots;

(3) The relationship between carrot prices at shipping points and wholesale terminal markets; and

(4) Possible reasons for shortrun variations in carrot prices at shipping points.

This study was limited to winter carrots marketed in 10 major consuming centers geographically dispersed across the United States. 3/ The basic data for the study consisted of Market News quotations of weekly average prices for carrots of good quality and condition at shipping points and at 10 wholesale terminal markets. The time period included the months of January, February, and March during the three winter seasons of 1966, 1967, and 1968.

Secondary data available on winter carrot prices consisted primarily of daily reports published by the Market News Service, Fruit and Vegetable Division, Consumer and Marketing Service, U.S. Department of Agriculture. These daily reports include the f.o.b. shipping-point prices of the common sizes and containers of carrots of good quality and condition, unless otherwise specified. At wholesale terminal markets, similar price series are quoted for produce available from first or primary receivers.

Daily prices of carrots were tabulated using the midpoints of the "mostly" range in price; that is, the price at which "most" of the carrots of good quality and condition were sold. A weekly unweighted average price was then computed by averaging the daily prices. Similar procedures were used at each consuming-center market except that tabulations took into consideration the shipping point or State of origin.

3/ The terms "consuming center" and "wholesale terminal market" are used interchangeably throughout this report.

THE WINTER CARROT INDUSTRY

The two major areas of winter carrot production are the Lower Rio Grande Valley of Texas and the southern half of California, mainly Riverside and Imperial Counties. In addition to the above-named regions, data on carrot shipments and unloads for the 1966-70 winter seasons included rail or truck movements from several other States, other parts of Texas and California, and imports from foreign countries. California and Texas provided 86 percent of the reported shipments and 88 percent of the unloads in 41 cities in the winters of 1966-70 (table 1).

In the winter of 1970, California was the main source of carrots for west coast cities, such as Los Angeles, San Francisco, and Seattle (table 2). Texas unloads dominated in eastern cities with the exception of Boston and Atlanta. Florida accounted for 56 percent of Atlanta unloads, while California was the source of 54 percent of Boston unloads.

According to the Crop Reporting Board, four counties in Texas and two in California produced 87 percent of the Nation's 1964 winter carrot crop (8). The 1964 Census of Agriculture reported that 520 farmers raising carrots in Hidalgo, Cameron, Willacy, and Starr Counties of Texas had average plantings of 57 acres each. Although only 35 carrot producers were counted in Imperial and Riverside Counties of California, their plantings averaged 193 acres each. Yields per acre were also much higher in California than in Texas.

In Texas, although some shippers own acreage, most firms handle carrots according to several other arrangements. These range from field buying to custom packing for a fixed handling charge. 4/ The general trend in the Lower Rio Grande Valley is toward fewer independent carrot producers and further integration of the growing-shipping operation. It is estimated that two-thirds to three-fourths of the winter carrot acreage during 1966-70 was owned outright by grower-shippers or was closely tied to shippers through contracts, leases, and other financial arrangements.

Although Texas carrot growers declined in number during the study period, the number of shippers held relatively steady. In the Lower Rio Grande Valley, there were 29 shippers in 1961, 33 in 1965, and an estimated 30 or 31 in 1968. The largest six or seven shippers each handled an average of 450-620 carlots annually during the period 1961-65. This volume has probably increased somewhat since 1965.

In 1968, agricultural extension agents in California estimated there were three or four carrot shippers in Imperial County and an additional five or six in Riverside County. Most shippers produced a large portion of their own

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4/ Much of the discussion on the operations of Lower Rio Grande Valley shippers was based on telephone interviews with personnel in the Marketing Field Office, Fruit and Vegetable Division, Consumer and Marketing Service, U.S. Department of Agriculture, McAllen, Tex., and the State Agricultural Experiment Station, Texas A&M University, Weslaco. Other information was obtained from "Carrot and Onion Prices and Market Structure in the Lower Rio Grande Valley of Texas," by J.C. Podany and R.W. Bohall, unpublished manuscript, U.S. Department of Agriculture.

Table 1.--Carrot unloads in 41 cities and reported shipments, by State of origin, as percentage of total, January, February, March 1966-70

Source	1966	1967	1968	1969	1970	Total, 1966-70	
	Carlots	Carlots	Carlots	Carlots	Carlots	Carlots	Percent
Unloads:							
Arizona	219	231	239	121	105	915	4.2
California	2,410	1,932	2,136	1,829	1,824	10,131	47.0
Texas	1,888	1,766	1,406	1,780	1,944	8,784	40.8
Florida	88	224	250	178	285	1,025	4.8
Other States	65	86	52	30	32	265	1.2
Imports	38	55	102	148	92	435	2.0
Total	4,708	4,294	4,185	4,086	4,282	21,555	100.0
Shipments:							
Arizona	430	328	443	217	191	1,609	5.7
California	1/3,000	1/2,286	3,095	2,600	2,108	13,089	46.5
Texas	2,117	2,355	1,287	2,400	2,987	11,146	39.6
Florida 2/	4	48	17	8	539	616	2.2
Other States	1	5	5	5	---	16	.1
Imports	109	422	588	375	184	1,678	5.9
Total	5,661	5,444	5,435	5,605	6,009	28,154	100.0

1/ Interstate shipments plus Los Angeles and San Francisco truck unloads from California.
2/ Rail only 1966-69; rail and interstate truck 1970.

Source: Consumer and Marketing Service, U.S. Department of Agriculture.

Table 2.--Absolute and relative shares of carrot unloads in selected cities, by State of origin, January, February, and March 1970

Destination	Origin										Total, United States	
	California		Arizona		Texas		Florida		Other States			
	Carlots	Pct.	Carlots	Pct.	Carlots	Pct.	Carlots	Pct.	Carlots	Pct.	Carlots	Pct.
Los Angeles	681	96	29	4	---	---	---	---	---	---	710	100
San Francisco	239	100	---	---	---	---	---	---	---	---	239	100
Dallas	6	5	6	5	102	89	1	1	---	---	115	100
Seattle	109	95	1	1	---	---	---	---	5	4	115	100
St. Louis	4	4	---	---	85	96	---	---	---	---	89	100
Chicago	73	28	6	2	176	67	7	3	---	---	262	100
Atlanta	---	---	---	---	32	44	40	56	---	---	72	100
Detroit	11	8	8	6	115	85	2	1	---	---	136	100
Pittsburgh	28	28	---	---	67	67	1	1	4	4	100	100
New York	178	41	14	3	211	49	24	6	2	1	429	100
Boston	97	54	6	3	49	27	28	16	---	---	180	100

Source: Consumer and Marketing Service, U.S. Department of Agriculture.

supplies, and independent growers were closely tied to shippers through various contractual and financial arrangements. The larger operators handled a thousand or more acres of carrots. Imperial County production was heaviest in April and May, but a steady outflow was maintained during the winter. The Coachella Valley near Indio, Calif., where most of the Riverside County acreage was located, had a fairly even flow from January through May.

Unlike lettuce, which is packed in the field, carrots are washed, sized, graded, and cooled in a packing shed. As mentioned earlier, carrots are commonly packed in mesh sacks holding 48 1-pound polyethylene (film) bags. The master containers may also be paper or plastic sacks or wirebound crates. The mesh containers are henceforth referred to as 48-1's mesh; the wirebound crates, as 48-1's w/b. Large or jumbo carrots are usually packed loose in 50-pound burlap or similar size bags. Carrots are ordinarily harvested mechanically and crews are often provided to growers by the shipper. In Texas, the combined fee for harvesting, packing, and selling carrots was estimated at $1.70-1.75 for the 1966-68 period--50 cents for harvesting, $1.10 for packing (including container), and 10 cents for selling per 48-1's mesh or 50-pound bag.

PRICE STRUCTURE

In a competitive marketing system, the lowest prices for produce will occur at the shipping point. Prices increase with distance and time to wholesale terminal markets, reflecting transportation, storage, and handling costs.

Market News weekly average carrot prices during the winters of 1966-68 were $3.72 for 48-1's mesh and $2.43 for 50-pound sacks in the Lower Rio Grande Valley of Texas (table 3). The price of 48-1's mesh was estimated at $3.90 for the same period in California. 5/ Average weekly Market News prices at wholesale terminal markets were all higher, generally rising with distance and time from the shipping point (fig. 1). Prices increased roughly 2.5 cents per 100 miles for carrots moving to eastern markets from both California and Texas origins.

Average wholesale terminal market prices for Texas carrots moving toward eastern consuming centers were $4.51 in Dallas, $4.62 in Chicago, and $4.78 in New York. Average prices in Detroit and Pittsburgh were high relative to New York. Texas carrots also move west in limited amounts to cities in Texas and New Mexico and to Denver, Colo.

An approximation of the price structure of California carrots was derived by utilizing data for five consuming centers. The highest average price was $5.72 for Seattle, reflecting, in part, the use of wirebound crates instead of

5/ F.o.b. shipping-point prices for carrots of good quality and condition are quoted by Market News for the Lower Rio Grande Valley of Texas. California shipping-point prices for the Imperial Valley and Riverside areas are normally not available until there is heavy movement, usually in late March. However, daily quotes are available from San Francisco. The f.o.b. shipping-point price for California carrots 48-1's mesh was estimated by using the San Francisco price of 48-1's mesh and allowing for transportation, handling, and storage costs between the Imperial Valley and San Francisco.

Table 3.--Weekly average f.o.b. carrot prices, Lower Rio Grande Valley, Tex., January, February, March 1966-68

Year and week ending--	Mesh masters 48-1's Medium-large	50-pound sack Large, loose
	Dollars	
1966:		
January 7	3.19	1.35
14	2.88	1.26
21	3.09	n.a.
28	3.58	1.50
February 4	3.73	1.59
11	3.75	1.54
18	3.55	1.42
25	3.46	1.29
March 4	3.23	1.32
11	3.00	1.26
18	3.16	1.44
25	2.89	1.56
April 1	3.10	2.00
Average, winter 1966	3.28	1.46
1967:		
January 6	2.51	1.42
13	2.50	1.50
20	2.60	1.49
27	2.45	1.41
February 3	2.25	1.30
10	2.23	1.36
17	2.12	1.30
24	2.07	1.22
March 3	2.00	1.25
10	2.16	1.23
17	2.12	1.25
24	2.04	1.34
31	2.20	1.31
Average, winter 1967	2.25	1.34
1968:		
January 5	6.62	4.68
12	7.46	5.00
19	7.81	5.00
26	7.44	5.00
February 2	6.84	4.81
9	6.06	4.75
16	5.93	4.92
23	5.88	5.13
March 1	5.47	4.87
8	4.44	4.31
15	3.72	3.70
22	3.03	2.84
29	2.53	2.46
Average, winter 1968	5.63	4.42
Average, three winters	3.72	2.43

n.a. = Not available.

Source: Market News Service, Consumer and Marketing Service, U.S. Department of Agriculture.

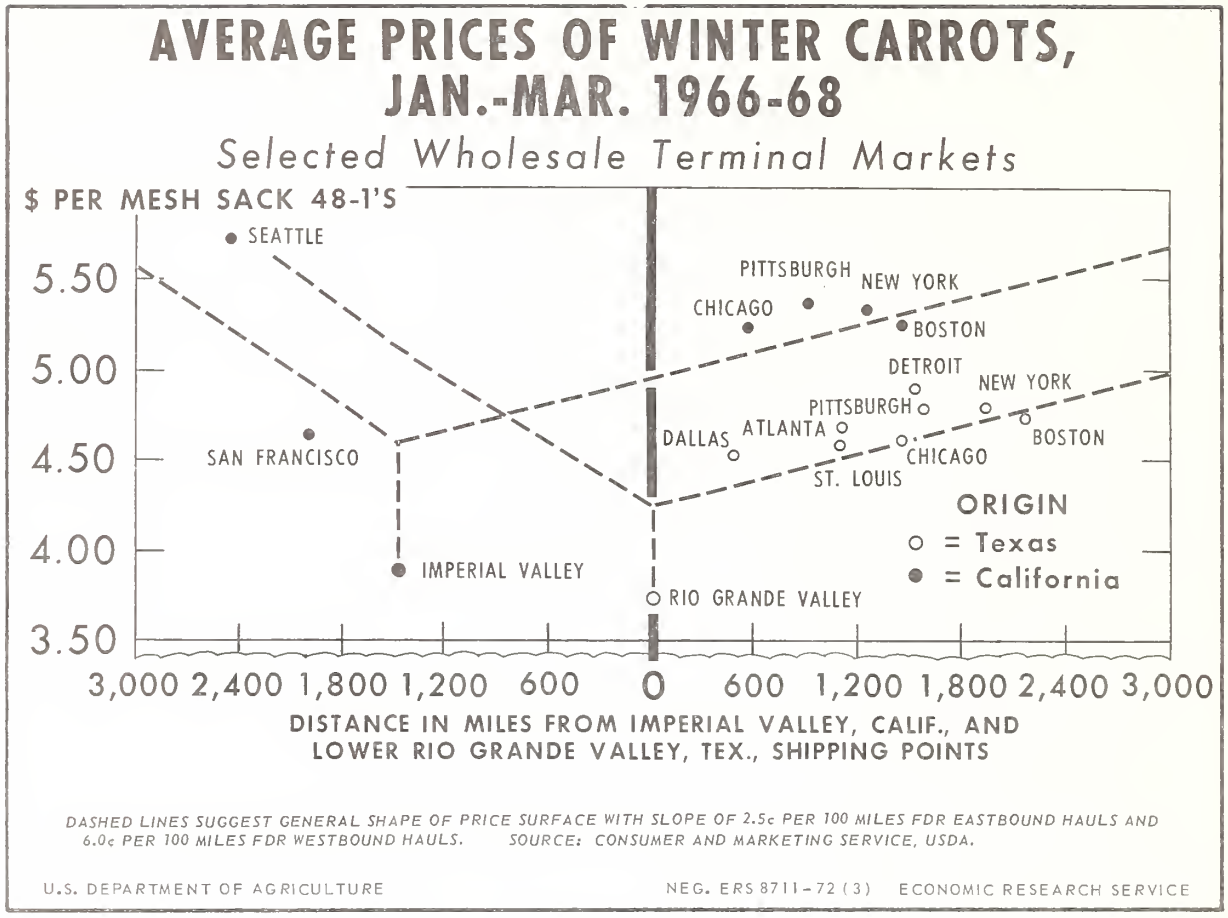

Figure 1

mesh masters in that city. In eastern markets, California carrots in 48-1's mesh commanded a premium of 50 to 60 cents per sack, compared with Texas carrots. The premium paid for California carrots averaged 62 cents in Chicago, 60 cents in Pittsburgh, 56 cents in New York, and 53 cents in Boston. Badger (1) reported that California carrots commanded a premium over Texas carrots of from 0.3 to 1.3 cents per bunch in Cleveland and Pittsburgh.

There is some evidence to indicate that differences in consuming-center prices for California and Texas carrots reflect consumer tastes and preferences. Telephone conversations with knowledgeable persons, including a large Chicago wholesaler, tended to confirm consumer preferences for California carrots. California carrots were described as having a sweeter taste, a smoother brighter appearance, a softer core, and better holding qualities than Texas carrots.

In figure 1, the dotted lines represent approximations of the level of consuming-center market prices for locations at varying distances from the Imperial Valley, Calif., and the Lower Rio Grande Valley, Tex. The bases of the cone-shaped price functions are shown to be higher than the shipping-point f.o.b. price. These reflect certain charges incurred in handling carrots, including loading, that are not directly associated with time or distance but are a part of shipping expenses.

The price structure of the winter carrot market was generally consistent with a competitive market. Prices of carrots of good quality and condition were lowest at the f.o.b. shipping point and increased with distance and time required for shipment to the wholesale terminal market.

COMPARISON OF COSTS AND MARGINS

The difference between shipping-point and consuming-center price--the gross margin--is directly related to the costs of transporting, handling, and storing produce. For winter carrots, the gross margin is the difference between shipping-point prices in the Imperial Valley, Calif., and the Lower Rio Grande Valley, Tex., and wholesale market prices. 6/ For the period studied, the average gross margin for California carrots ranged from 73 cents per 48-1's mesh in San Francisco to $1.80 48-1's w/b in New York City (table 4). The average gross margin for Texas carrots per 48-1's mesh ranged from 79 cents in Dallas to $1.46 in Pittsburgh.

Gross carrot margins were divided into transportation costs and residual margins. The procedure used was to measure transportation costs from shipping points to selected consuming centers. Gross margins minus transportation costs equaled residual margins.

Transportation costs are the major component of gross margins. From January through March 1966-70, Market News reported a total of 21,753 carlot unloads of winter carrots from all sources in 41 cities. Of these, 63.3 percent moved by truck and 36.7 percent by railcar, including 0.9 percent by piggyback or truck vans loaded onto rail flatcars (table 5).

Truck transportation was used primarily for nearby markets such as Los Angeles, San Francisco, and Dallas. Trucks were also used for some shipments to Seattle, Atlanta, Chicago, Pittsburgh, and St. Louis, although quoted truck rates to these cities were sometimes higher than rail rates (table 6). Since carrots were an exempt commodity, rates below those quoted were sometimes in effect, depending on the relative demand for trucks. Rail transportation generally was used for long-distance hauls for both California and Texas supplies. Rail transportation was predominantly used for deliveries to Boston, Chicago, Detroit, New York, and Pittsburgh.

Both rail and truck facilities were used to move Texas carrots to eastern markets. Truck rates were generally higher than rail rates, with premiums of 17 cents to Atlanta, 20 cents to St. Louis, and 51 cents to Boston. Despite the higher rates, over half the Texas shipments to Atlanta and St. Louis moved by truck. However, the relatively high premium for truck service from Texas to New York City and Boston virtually eliminated the use of this mode of transportation for carrot shipments.

6/ The term "gross margin," as used in this report, differs from the marketing margins used in many USDA studies. The marketing margin refers to the difference between the shipping-point price and the retail price. Here, the gross margin does not include the wholesale-retail portion of the total price spread.

Table 4.--Breakdown of average weekly gross margins between carrot prices per 48-1's mesh at shipping points and 10 selected consuming-center markets, January, February, March 1966-68

Consuming center	Consuming-center price	Shipping-point price		Gross margin	Transportation	Residual margin	
		Texas	California 1/			California	Texas
	Dollars						
San Francisco	4.63	---	3.90	0.73	0.44	0.29	---
Seattle	2/5.72	---	3/4.25	1.47	1.03	.44	---
Dallas	4.51	3.72	---	.79	.42	---	0.37
St. Louis	4.58	3.72	---	.86	.55	---	.31
Chicago	5.24	---	3.90	1.34	.92	.42	---
Chicago	4.62	3.72	---	.90	.64	---	.26
Atlanta	4.68	3.72	---	.96	.58	---	.38
Detroit	4.90	3.72	---	1.18	.69	---	.49
Pittsburgh	5.36	---	3.90	1.46	1.12	.34	---
Pittsburgh	4.76	3.72	---	1.04	.72	---	.32
New York	2/6.05	---	3/4.25	1.80	1.25	.55	---
New York	5.34	---	3.90	1.44	1.15	.29	---
New York	4.78	3.72	---	1.06	.89	---	.17
Boston	5.26	---	3.90	1.36	1.15	.21	---
Boston	4.73	3.72	---	1.01	.89	---	.12
Simple average	---	---	---	---	---	.33	.30
Weighted average 4/	---	---	---	---	---	.32	.26

1/ California shipping-point price was derived from San Francisco market price by allowing an average 0.29 cent residual margin for 48-1's mesh in San Francisco.
2/ Sold in wirebound crates.
3/ Allows 35 cents for the additional cost of wirebound crate.
4/ Weighted by unloads in each city.

Source: Market News Service, Consumer and Marketing Service, U.S. Department of Agriculture.

Table 5.--Carrot unloads in selected cities of supplies originating in California-Arizona and Texas and total, all origins, January, February, March 1966-70

Destination	California-Arizona				Texas				Total, all origins 1/			
	Rail	Piggy-back	Truck	Total	Rail	Piggy-back	Truck	Total	Rail	Piggy-back	Truck	Total
	Carlots											
Los Angeles	---	---	4,388	4,388	---	---	---	---	---	---	4,388	4,388
San Francisco	4	---	1,225	1,229	---	---	1	1	4	---	1,226	1,230
Dallas	14	2	87	103	---	---	428	428	14	2	516	532
Seattle	94	---	518	612	---	---	---	---	94	---	555	649
St. Louis	6	---	40	46	78	53	210	341	86	53	255	394
Chicago	424	31	52	507	590	19	188	797	1,022	51	259	1,332
Atlanta	1	---	2	3	51	---	125	176	52	---	292	344
Detroit	79	---	7	86	435	---	91	526	516	---	119	635
Pittsburgh	32	---	86	118	183	---	87	270	220	---	251	471
New York	1,069	17	31	1,117	1,044	---	36	1,080	2,130	30	198	2,358
Boston	462	6	1	469	443	---	5	448	913	6	84	1,003
Total, 41 cities	3,223	n.a.	7,823	11,046	4,420	n.a.	4,364	8,784	7,784	2/198	13,771	21,753

n.a. = Not available.

1/ Includes imports.
2/ Data for 1966 not available.

Source: Consumer and Marketing Service, U.S. Department of Agriculture.

Table 6.--Transportation rates of carrots, 48-1's mesh, from selected shipping points to selected cities, January, February, March 1968

Destination	Shipping point			
	California-Arizona		Lower Rio Grande Valley, Tex. 1/	
	Rail 2/	Truck	Rail	Truck
	Dollars			
Los Angeles	---	3/0.30	1.27	0.80
San Francisco	---	.44	1.27	.90
Seattle	---	1.03	1.32	---
Dallas	0.87	.60	---	.42
St. Louis	.92	1.08	.55	.75
Chicago	.92	1.14	.64	.85
Atlanta	1.12	1.14	.58	.75
Detroit	1.08	1.36	.69	.95
Pittsburgh	1.12	1.63	.72	1.10
New York	4/1.15	1.80	.89	1.30
Boston	1.15	1.90	.89	1.40

1/ 50,000-pound minimum on rail; 40,000-pounds on trucks with refrigeration, assuming 48-1's mesh weigh 56 pounds with proper icing.
2/ 50,000-pound minimum with mechanical refrigeration; 1969 rates approximately 5 cents higher.
3/ 50-pound sack.
4/ Wirebound $0.10 higher.

Sources: Southern Pacific Railroad Company, Phoenix, Ariz., and Colton, Calif.; survey of truck brokers, Phoenix, Ariz., and El Centro, Calif.; Texas Citrus and Vegetable Growers and Shippers Association, Harlingen, Tex.

The convenience and speed of truck transportation relative to rail service evidently are factors in the shipment of Texas carrots to eastern markets. Competition by truckers for loads may also reduce rates below the average. Since very little piggyback transportation was used for winter carrots, rates for this mode were not reported.

The remaining component of gross carrot margins is the residual margin. The residual margin goes to wholesale receivers and other first handlers to compensate for unloading and breaking large lots of produce into smaller wholesale units and to compensate for risks and uncertainty in holding produce through time.

An average residual margin of 29 cents, or approximately $220 per carlot of 760 mesh masters, was representative for California and Texas carrots (table 4). Manchester (5) estimated that receivers in 1958 required a residual margin of $250 per carlot for all fruits and vegetables, and that a gross margin of 13.2 percent of consuming-center prices was received by primary handlers--6.7 percent for salaries and wages, 5.4 percent for other costs, and 1.1 percent for net income, including 0.2 percent corporate income tax. Allowing for increases in the cost of labor and other services between 1958 and 1966-68, an indicated residual margin of 29 cents per 48-1's mesh was not out of line. The relatively low return per carlot of carrots, compared with more perishable vegetables such as lettuce (2), was due in part to lower spoilage losses and less risk in handling. 7/ Most carrots for fresh market are harvested while still immature. If immature carrots are cooled quickly before packaging--hydrocooled, for example--they can be held 4-6 weeks at 32° F. (4).

The residual margin for Texas carrots, 48-1's mesh, ranged from 12 cents in Boston to 49 cents in Detroit. Residual margins in Detroit were 23 cents above the average of eight cities receiving Texas carrots. Detroit, which receives nearly all of its winter carrots from Texas, is not a diversion point since a backhaul would be necessary to divert carrots from Detroit toward eastern cities. To the extent shippers are reluctant to send carrots into the Detroit market without a firm commitment from buyers, excess or uncommitted supplies would be less and prices higher than if the city were a diversion point.

Data are not available on California shipping-point carrot prices for most of the 1966-68 winter (January-March) seasons. 8/ Residual margins for California carrots were obtained by setting the average residual margin for mesh masters in San Francisco at 29 cents. Therefore, the average shipping-point price in the Imperial Valley would have been $3.90 per mesh master or 16 cents more than in Texas. Based on a shipping-point price of $3.90, residual margins

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7/ Residual margins appear to vary according to the perishability of the commodity. For the winters of 1966-68, the weighted average residual margin for lettuce was 10.6 percent. During the same period, the average residual margin for Texas carrots was 5.1 percent and for southern Florida tomatoes, 11.4 percent. Since tomatoes and lettuce are relatively more perishable than carrots, residual margins apparently are related to the perishability of the produce item. R.W. Bohall. Pricing Performance of the Marketing System for Selected Fresh Winter Vegetables. Unpublished Ph.D. thesis, N.C. State Univ., 1971. (Univ. Microfilms, Ann Arbor, Mich.).

8/ See footnote 5.

for mesh masters from California would range from 21 cents in Boston to 42 cents in Chicago. In general, the indicated residual margins for California carrots in mesh master containers were higher in the same city than Texas mesh masters. This was true in New York, Pittsburgh, Chicago, and Boston. Residual margins for wirebound crates in New York and Seattle tended to be larger than for mesh masters. Residual margins estimated for California carrots can only be interpreted with respect to market differences. Whether the magnitude of the residual margins was correct depends entirely upon the validity of the assumption regarding the residual margin in San Francisco.

Residual margins for carrots in cities close to the shipping point tended to be nearly as high or higher than for more distant cities. Average residual margins for Texas carrots were 37 cents in Dallas, 38 cents in Atlanta, 49 cents in Detroit, but only 17 cents in New York City. Similarly, residual margins on California carrots were 29 cents in San Francisco, 42 cents in Chicago, 34 cents in Pittsburgh, and 29 cents in New York City. The main cost of holding produce through time is associated with quality losses, although for a so-called "hardware" vegetable like carrots, spoilage is not a major concern. Costs of holding carrots while in transit are also negligible. 9/

Residual margins differed considerably between cities and years (table 7). Average residual margins for Texas 48-1's mesh were 10, 20, and 52 cents in the winters of 1966, 1967, and 1968, respectively. These corresponded to average shipping-point prices in the Lower Rio Grande Valley of $3.28, $2.25, and $5.63. Since carrot prices averaged much higher in the winter of 1968, compared with the winters of 1966 and 1967, the residual margin was evidently influenced by the consuming-center price level. In fact, the residual margin, as a percentage of the consuming-center price, averaged 7.6 percent in the winter of 1968 and 2.3 percent and 6.3 percent, respectively, in 1966 and 1967 (table 8). Thus, the weighted average residual margin tended to increase with the price of winter carrots.

Higher consuming-center carrot prices might be associated with higher residual margins for the following reasons:

First, relatively high prices for winter carrots occur when quality is poor and supplies of carrots of good quality and condition are limited. With poor quality, the probability of losses due to spoilage is likely to increase at wholesale terminal markets. As a result, higher residual margins are needed to cover handling costs.

Second, the capital or investment required to handle an inventory of carrots is directly associated with price. Hence, relatively higher residual margins would be needed to cover higher investment costs when prices of winter carrots increase.

Third, commission merchants and other primary or first handlers of carrots in wholesale terminal markets often base charges for their services upon selling

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9/ New York average price $5.35 x 760 sacks per carlot x 7 days = $28,411. San Francisco average price $4.63 x 760 sacks x 1 day = $3,519. Interest on $24,892 ($28,411-$3,519) at 8 percent per annum for 1 day = $5.46 per carlot or 7/10 cent per mesh sack 48-1's.

Table 7.--Breakdown of the average weekly gross margin between carrot prices, 48-1's mesh, in the Lower Rio Grande Valley, Tex., and eight selected wholesale terminal markets, by years, January, February, March 1966-68

Destination	Shipping-point price f.o.b. Texas			Transportation cost, all winters	Wholesale terminal market price			Residual margin 1/		
	Winter 1966	Winter 1967	Winter 1968		Winter 1966	Winter 1967	Winter 1968	Winter 1966	Winter 1967	Winter 1968
	Dollars									
Atlanta	3.28	2.25	5.63	0.58	4.15	3.09	6.79	0.29	0.26	0.58
Boston	3.28	2.25	5.63	.89	4.23	3.11	6.85	.06	-.03	.33
Chicago	3.28	2.25	5.63	.64	4.08	3.03	6.75	.16	.14	.48
Dallas	3.28	2.25	5.63	.42	3.77	2.99	6.76	.07	.32	.71
Detroit	3.28	2.25	5.63	.69	4.31	3.36	7.02	.34	.42	.70
New York	3.28	2.25	5.63	.89	4.12	3.27	6.95	-.05	.13	.43
Pittsburgh	3.28	2.25	5.63	.72	4.19	3.21	6.88	.19	.24	.53
St. Louis	3.28	2.25	5.63	.55	3.99	3.07	6.70	.16	.27	.52
Simple average	---	---	---	---	4.10	3.14	6.84	.20	.29	.54
Weighted average 2/	---	---	---	---	4.11	3.17	6.85	.10	.20	.52

1/ Residual margin = wholesale terminal market price minus shipping-point price and transportation cost.
2/ Weights based on unloads.

Source: Wholesale terminal market prices derived from Market News Service, Consumer and Marketing Service, U.S. Department of Agriculture.

Table 8.--Residual margin as a percentage of wholesale terminal market price of carrots, 48-1's mesh, Texas origin, eight selected cities, January, February, March 1966-68

Destination	Winter 1966	Winter 1967	Winter 1968	Weighted average, 3 winters 1/
	Percent			
Atlanta	7.0	8.4	8.5	7.7
Boston	1.4	-1.0	4.8	1.4
Chicago	3.9	4.6	7.1	5.1
Dallas	1.9	10.7	10.5	7.6
Detroit	7.9	12.5	10.0	10.4
New York	-1.2	4.0	6.2	2.1
Pittsburgh	4.5	7.5	7.7	6.7
St. Louis	4.0	8.8	7.8	7.0
Simple average	3.7	7.0	7.8	---
Weighted average 1/	2.3	6.3	7.6	5.1

1/ Weighted by unloads.

Source: Derived from table 7.

prices; that is, a commission or percentage of selling price. As a result, residual margins and wholesale terminal market prices are directly correlated.

Between the winters of 1966 and 1967, relative residual margins increased for seven of the eight selected cities handling Texas carrots. The consuming-center price of Texas 48-1's mesh declined between the two winter seasons, yet residual margins increased 10 cents on the average. Had residual margins been established on a percentage or absolute formula, they would have decreased or remained steady between the two periods. California carrot production declined relative to Texas during the period. As a result, the market share of California-Arizona unloads compared with Texas declined in six selected cities and increased only in Boston (table 9). In Atlanta, the percentage of unloads from other States, primarily Florida, increased, reducing the share of the market held by Texas. The residual margin for Texas carrots declined in both cities--Atlanta and Boston--where the proportion of unloads coming from Texas decreased between the winters of 1966 and 1967. Conversely, for five of the six cities where the Texas market share increased or held steady and the California-Arizona market share decreased, the residual margin on Texas carrots increased.

Table 9.--Percentage of total unloads of carrots in eight selected cities, by State of origin, and change in residual margins for Texas carrots, January, February, March 1966 and 1967

Destination	State of origin				Change in residual margin between winters of 1966 and 1967
	Texas		Calif.-Ariz.		
	Winter 1966	Winter 1967	Winter 1966	Winter 1967	
	Percent				Cents
Atlanta	80	42	--	--	- 3
Boston	58	52	38	41	- 9
Chicago	53	57	47	40	- 2
Dallas	72	92	28	8	+25
Detroit	78	95	20	5	+10
New York	49	49	49	45	+18
Pittsburgh	58	63	28	13	+ 5
St. Louis	75	91	18	9	+11

Source: Derived from table 7 and Market News Service, Consumer and Marketing Service, U.S. Department of Agriculture.

Also of interest was the relationship between the absolute residual margin for Texas 48-1's mesh and the market share for Texas. In the winter of 1966, the cities with the highest residual margins for Texas 48-1's mesh--Detroit and Atlanta--also had the largest proportion of unloads from Texas; the opposite in terms of size of residual margin and unloads was observed for New York (tables 7 and 9). Similarly, in the winter of 1967 the highest residual margins for Texas 48-1's mesh were observed in Dallas, Detroit, and St. Louis; these cities also received over 90 percent of their carrot unloads from Texas. Conversely, the lowest residual margins for Texas 48-1's mesh occurred in Boston and New York, both of which received roughly half their unloads from Texas.

Thus, it appeared that the residual margin on Texas 48-1's mesh was positively correlated with the proportion of unloads in any given consuming-center market originating in Texas. At least for the winters of 1966 and 1967, changes in the residual margin were positively correlated with changes in Texas' market share of unloads. Stated another way, the greater the share of total market carrot unloads from California-Arizona, the lower the residual margin on Texas 48-1's mesh. This trend did not hold into the winter of 1968 when Texas had a poor carrot crop. Residual margins on Texas carrots increased for most cities while the market share for Texas declined. Over time in a competitive market, residual margins for carrots from both Texas and California should be nearly equal, reflecting comparable costs of storage and handling.

Costs of transporting carrots accounted for over 53 percent of the gross margins between the shipping point and the wholesale terminal market for all 10 selected cities in the study. Transportation costs were less for truck than rail shipments over short distances; the reverse was true for long distances.

The average residual margin for carrots was 29 cents per 48-1's mesh. While a detailed study of handling and storage costs was not possible, previous research indicated that a 29-cent residual margin was not inconsistent with measured marketing costs. In Detroit, residual margins were high relative to other consuming centers in the study. For the winters of 1966 and 1967, residual margins on Texas carrots within individual cities were directly correlated with the percentage of unloads coming from Texas. Residual margins were not related to the time carrots were in transit but were related to the absolute price of carrots and the perishability of the commodity.

Overall, observed differences between shipping-point and wholesale terminal-market carrot prices and actual costs of transporting, handling, and storing carrots, while not perfectly correlated, were generally consistent with a competitive marketing system.

RELATIONSHIP OF WHOLESALE TERMINAL MARKET AND SHIPPING-POINT PRICES

Shipping points represent produce market centers in which there is frequent direct interaction between buyers and sellers, especially the larger and more important chain stores and other direct wholesale buyers. Hence, in the short run, price changes frequently first occur at shipping points, then are reflected at other locations in the marketing system. At wholesale terminal markets, direct buyers have a portion of their weekly supplies arriving from shipping points, and need only to supplement their direct receipts with supplies from the local terminal. As a result, direct buyers are keenly aware of the price differential between the wholesale terminal market and the various shipping points with which they have contact.

Four possibilities exist when wholesale terminal market buyers obtain some of their produce direct:

(1) When wholesale terminal market supplies are required to fill expected needs of customers and the shipping-point price is high relative to the wholesale terminal market price, the buyer will purchase from the local wholesale terminal;

(2) When wholesale terminal market supplies are required to fill expected needs of customers and the shipping-point price is low relative to the price at the wholesale terminal market, the buyer will delay or cancel some purchases on the local market and buy extra supplies direct from the shipping point;

(3) When wholesale terminal market supplies are not needed to fill expected needs of customers and the shipping-point price is high relative to the wholesale terminal market price, the buyer may make some purchases locally for future use but decrease direct buying;

(4) When wholesale terminal market supplies are not required to fill expected needs of customers and the shipping-point price is low relative to the wholesale terminal market price, buyers will not purchase from the local wholesale terminal and make some purchases direct from shipping point for future use.

The reaction of direct buyers to the price differential between the wholesale terminal market and the shipping point will be felt at the shipping point as soon as direct purchases are moved or fail to move to the wholesale terminal.

In addition to the possibility of obtaining supplies from shipping points, local wholesale handlers and retail organizations may have an additional option of buying uncommitted supplies (rollers) en route to wholesale terminal markets. These supplies, if available, may be (1) in the hands of brokers; (2) assigned to commission merchants on the local terminal market; or (3) approaching major diversion points for eastern carrot buyers such as St. Louis or Chicago and still be uncommitted by the shipper. Still another option is to obtain supplies from other nearby wholesale terminal markets.

The ability of direct buyers to purchase carrots from shipping points, from uncommitted supplies en route, and from other wholesale terminal markets suggests that prices at all locations in the marketing system will be closely related. As a test, the relationships between the f.o.b. shipping point and selected city carrot prices were measured for the winters of 1966-68. Market News data were used to derive a weekly f.o.b. shipping-point price of Texas carrots and the weekly price of Texas and California carrots in each of the 10 selected cities. Prices of 48-1's mesh of California origin were available for the San Francisco consuming center and were utilized as a proxy for the Imperial Valley shipping-point price. Correlation analysis was used to compare prices, and regression analysis was used to measure the relationship between prices at shipping points and at wholesale terminal markets.

Current Prices

In general, consuming-center market prices were closely correlated with shipping-point prices of winter carrots, especially in the Lower Rio Grande Valley (table 10). In all cities the correlation between shipping-point and consuming-center prices was 0.94 or better, indicating that increases in shipping-point carrot prices were, on the average, positively associated with increases in consuming-center prices of winter carrots. It was particularly noteworthy that prices of 48-1's mesh at all consuming centers were closely correlated with the Texas shipping-point price, whether or not Texas shipped carrots to the consuming center. For example, the correlation between prices of Lower Rio Grande Valley carrots and San Francisco prices of California carrots was 0.97, although Texas did not ship carrots to San Francisco.

Distance or time apparently did not influence the strength of correlations with Texas prices or with San Francisco prices. Correlation coefficients for Boston and Seattle were as high as for Dallas, St. Louis, and Atlanta, which are closer to the shipping point. It was concluded, therefore, that consuming-center prices of 48-1's mesh, regardless of origin, were closely related to the price of 48-1's mesh at the Lower Rio Grande Valley shipping point.

Table 10.--Correlation coefficients between weekly average shipping-point and consuming-center carrot prices, 48-1's mesh, January, February, March 1966-68

Consuming-center market	Origin	Shipping point	
		Rio Grande Valley, Tex.	San Francisco, Calif.
Dallas	Texas	0.98	--
St. Louis	Texas	.98	--
Atlanta	Texas	.97	--
Chicago	Texas	.99	--
Chicago	California	.98	0.96
Detroit	Texas	.98	--
Pittsburgh	Texas	.99	--
Pittsburgh	California	.99	.97
San Francisco	California	.97	--
New York	Texas	.97	--
New York 1/	California	.98	.96
New York	California	.96	.94
Boston	Texas	.98	--
Boston	California	.98	.96
Seattle 1/	California	--	.97

1/ Wirebound crates.

Since correlations were extremely high between shipping points and wholesale terminal markets, city to city price relationships might be expected to be just as strong. This was confirmed by the matrix of correlation coefficients between consuming-center carrot prices, as shown in table 11. The lowest correlation was 0.90, and only 10 of the 105 correlations measured were less than 0.95. In every price series there was at least one other price series in which the correlation was 0.98 or better. This implies that 96 percent or more of the variation in each carrot price was associated with variation in another set of carrot prices. The upper left triangle of table 11 indicates correlations of Texas prices; the lower right triangle, correlations of California prices. The Texas correlations are slightly stronger but differences are minor. Prices of carrots from different origins were strongly correlated in four eastern markets where both California and Texas carrots were available.

Table 11.--Correlation coefficients between weekly average carrot prices, 48-1's mesh, selected cities, January, February, March 1966-68 1/

Destination	Origin	Texas origin							California origin						
		Boston	Chicago	Dallas	Detroit	New York	Pittsburgh	St. Louis	Boston	Chicago	New York	New York W/B	Pittsburgh	San Francisco	Seattle W/B
Atlanta	Texas	0.96	0.98	0.99	0.98	0.96	0.98	0.99	0.96	0.97	0.93	0.94	0.98	0.97	0.97
Boston	Texas		.97	.97	.96	.97	.98	.97	.99	.97	.97	.97	.98	.96	.94
Chicago	Texas			.98	.99	.98	.99	.99	.97	.99	.96	.97	.99	.97	.95
Dallas	Texas				.99	.96	.99	2/100	.96	.98	.94	.95	.98	.98	.98
Detroit	Texas					.97	.98	.99	.95	.99	.93	.95	.98	.96	.97
New York	Texas						.97	.97	.96	.98	.95	.96	.98	.95	.94
Pittsburgh	Texas							.99	.98	.98	.96	.97	.99	.98	.96
St. Louis	Texas								.97	.98	.95	.96	.98	.97	.98
Boston	California									.96	.98	.98	.98	.97	.93
Chicago	California										.95	.97	.99	.96	.95
New York	California											.99	.96	.94	.90
New York 3/	California												.97	.96	.92
Pittsburgh	California													.97	.95
San Francisco	California														.97

1/ Coefficients were rounded to the nearest percent.
2/ 0.995 or more.
3/ Wirebound crates.

Reasons why carrot prices may be correlated more closely than either lettuce or tomatoes, the other two vegetables studied, are twofold. 10/ First, carrot prices tend to be more stable within each marketing season. While wide shifts were observed between seasons, prices within each winter season do not vary as widely as those of other vegetables. Second, since carrots are less perishable than many vegetables, they can be stored in the ground or their marketing delayed; this helps reduce the frequency and magnitude of price changes at shipping points and consuming-center markets. In general, consuming-center price correlations were high for cities located close together and also for more distant locations.

Price Prediction

Based on the physical flow of produce and on buying practices, it was expected that shipping-point and wholesale terminal market prices would be directly related. Consuming-center prices can be expressed as equal to the shipping-point price plus transportation, handling and storage costs, and a random error. In a regression framework this may be written as:

$$Y_{ijk} = a_{ij} + b_{ij} Y_{Cjk}$$

where

Y_{ijk} = consuming center market price for carrots in 48-1's mesh for consuming center market i, origin j, week k;

Y_{Cjk} = the blend f.o.b. price of carrots at shipping point j in week k;

i = Atlanta, Boston, Chicago, Dallas, Detroit, New York, Pittsburgh, St. Louis, San Francisco, and Seattle;

j = shipping point = Texas or California. The San Francisco price of 48-1's was used as a proxy for California shipping-point prices;

k = weeks 1-39 with 1-13 = winter 1966; 14-26 = winter 1967; 27-39 = winter 1968.

The null hypothesis tested was that each regression coefficient b_{ij} associated with Y_{Cjk} was equal to 1.0 or H_o: B = 1. For each of eight cities receiving Texas carrots this hypothesis was not rejected at the 5-percent level of significance (table 12, equations 12.01 to 12.08). It was concluded that the consuming-center market price of Texas carrots was equivalent to the Lower Rio Grande Valley price plus a constant representing transportation, storage, and handling charges.

For example, using the data in table 12, the price of Texas carrots in the Atlanta market could be predicted by adding 96 cents to 0.999 times the Lower Rio Grande Valley price of Texas carrots. If the Lower Rio Grande Valley price was $3.00, the expected price in Atlanta would be $3.96.

10/ Pricing Performance of the Marketing System for Selected Fresh Winter Vegetables. For complete citation, see footnote 7.

Table 12.--Simple regressions of consuming-center carrot prices on shipping-point prices, 48-1's mesh, weekly data, January, February, March 1966-68

Equation Number	Consuming-center market price: City	Consuming-center market price: Origin	Independent variable 1/	Number of observations	Constant Term	Regression coefficient 2/	Standard error	Correlation coefficient	Test of $H_0: b_1=1$ 3/
12.01	Atlanta	Texas	T	39	0.96	0.999	0.040	0.971	n.s.
12.02	Boston	Texas	T	39	.76	1.066	.039	.976	n.s.
12.03	Chicago	Texas	T	39	.68	1.061	.030	.985	n.s.
12.04	Dallas	Texas	T	39	.64	1.040	.037	.977	n.s.
12.05	Detroit	Texas	T	39	1.04	1.035	.031	.983	n.s.
12.06	New York	Texas	T	39	.87	1.034	.041	.972	n.s.
12.07	Pittsburgh	Texas	T	39	.88	1.044	.029	.986	n.s.
12.08	St. Louis	Texas	T	39	.89	.992	.030	.983	n.s.
12.09	Boston	Calif.	S	39	-.09	1.157	.054	.962	**
12.10	Chicago	Calif.	S	39	.54	1.016	.048	.961	n.s.
12.11	New York	Calif.	S	39	.14	1.124	.069	.938	n.s.
12.12	New York 4/	Calif.	S	39	1.03	1.087	.054	.957	n.s.
12.13	Pittsburgh	Calif.	S	39	.22	1.112	.046	.970	*
12.14	Seattle 4/	Calif.	S	39	1.03	1.015	.041	.971	n.s.

1/ Shipping-point price S = San Francisco; T = Texas.
2/ All regression coefficients are significantly different from zero at the 0.005 level.
3/ n.s. = Not significant; * = significant at the 5-percent level; ** = significant at the 1-percent level.
4/ w/b = Wirebound crates.

The same type of relation held for four of the six cities tested receiving 48-1's mesh from California (equations 12.09-12.14). San Francisco prices were used as a proxy for California shipping-point prices in these tests.

In 12 of the 14 equations, the regression coefficient was greater than 1.0, indicating some tendency for gross margins to be positively correlated with the level of the shipping-point price. This is consistent with the general practice of commission merchants in large metropolitan areas who typically charge a fee based on a percentage of the sales price. In Boston, Chicago, New York, and Pittsburgh, within-city price comparisons were possible between 48-1's mesh from California and Texas. Simple regression analysis was used to ascertain the relationship between the prices of Texas and California carrots (table 13). 11/ Equations 13.1, 13.4, and 13.5 indicated that in three of the four cities the price of 48-1's in mesh masters from California was equal to the price of the comparable package of Texas carrots in the market plus a constant premium. The relationship in equations 13.2 and 13.3 was more complex, indicating a regression line with a flatter slope but with a higher intercept. Hence, equation 13.2 indicates that the absolute amount paid for California carrots was greater with lower priced Texas carrots than with higher priced Texas 48-1's mesh. A similar relation held between California wirebound crates and mesh masters of 48-1's in New York. On the average, the premium paid for California carrots in 48-1's mesh was 50-60 cents in New York, Pittsburgh, Chicago, and Boston. In addition, in the New York market, California carrots packed in wirebound crates commanded a 72-cent edge over mesh masters holding 48 1-pound film bags from California.

It was concluded, therefore, that wholesale terminal market and shipping-point carrot prices were closely related and were consistent with prices in a competitive marketing system.

PRICE PREDICTION AT SHIPPING POINT

California and Texas carrot prices were found to be closely associated with wholesale terminal market prices at other locations in the marketing system. Hence, if the level and variations in prices could be predicted or explained at these shipping points, prices or shifts in price for the entire marketing system would be predictable.

Week-to-week variations in shipping-point carrot prices result from shifts in the supply of carrots. The quantity of carrots available in any given week is determined by plantings scheduled several weeks previously. Although feasible, carrot shipments are rarely postponed since it is not desirable to delay harvest once maturity is reached and storage of the perishable crop is generally impractical due to lack of facilities. With predetermined weekly supplies, predicting carrot prices becomes a problem of estimating the relationship between the shipping-point price and the quantity of carrots available. 12/

11/ A direct causal relationship is not implied in the price predicting equations in table 13.

12/ The demand at the shipping point for winter carrots was assumed fixed over the winter seasons of 1966 to 1968. This implies that the net effect of changes in consumer tastes and preferences, population, consumer income, the prices of related goods, and the range of goods available did not cause a shift in the relationship between shipping-point price and quantity of carrots during the study period.

Table 13.--Simple regressions of carrot price to price relationships within consuming-center markets, weekly, January, February, March 1966-68

Equation Number	Dependent price variable	Independent price variable	Number of observations	Constant term	Regression coefficient	Standard error	r^2	Test of H_o:B=1.0 1/	$\bar{Y}$ minus $\bar{X}$ 2/
									Dollars
13.1	Boston 48-1's California	Boston 48-1's Texas	39	0.32	1.045	0.028	0.974	n.s.	0.52
			--	--	--	--	--	--	--
13.2	Chicago 48-1's California	Chicago 48-1's Texas	39	.94	.932	.024	.977	**	.63
			--	--	--	--	--	--	--
13.3	New York w/b California	New York 48-1's California	39	1.04	.938	.022	.980	**	.71
			--	--	--	--	--	--	--
13.4	New York 48-1's California	New York 48-1's Texas	39	.49	1.029	.056	.902	n.s.	.61
			--	--	--	--	--	--	--
13.5	Pittsburgh 48-1's California	Pittsburgh 48-1's Texas	39	.45	1.031	.024	.981	n.s.	.60
			--	--	--	--	--	--	--

1/ n.s. = Not significant; ** = significant at the 1-percent level.
2/ $\bar{Y}$ = Dependent variable; $\bar{X}$ = independent variable.

Weekly observations of Texas price and California-Arizona and Texas quantity were used to estimate prices for winter carrots in the Lower Rio Grande Valley of Texas. Data on shipments were supplemented by data on unloads to obtain California movement in the winters of 1966 and 1967 and to approximate Texas movement during 10 weeks of the 1968 winter season. 13/

For the period studied, weekly carrot supplies averaged 158 carlots from Texas and 246 carlots from California-Arizona (app. table 1). The heaviest shipments of 233 carlots from Texas occurred during the week ending February 18, 1967; the lightest--70 carlots--during the week ending January 29, 1966. California movement ranged from 312 carlots for the week ending March 16, 1968, to a low of 147 carlots for the week ending January 7, 1967.

Ideally, price and quantity data for carrots of good quality and condition in 48-1's mesh would have been available to estimate the price of carrots of good quality and condition. While price data for Texas were available (table 3), data on the quantity available did not distinguish between grade and size of produce. The quantity of carrots of good quality and condition in 48-1's mesh was considered a portion of total carrot supplies.

In estimating the price of carrots in the Lower Rio Grande Valley, rainfall and temperature variables were introduced to act as proxies for changes in the distribution of quality and size of produce. Changes in the proportion of different qualities and sizes of carrots, while not necessarily influencing shipments, would offset Market News prices quoted for produce of good quality and condition. If weather conditions result in a high proportion of smaller sized carrots and/or poor quality carrots, the price of 48-1's mesh of good quality and condition would be expected to be higher than for a comparable period when the crop was nearly all of good quality and condition.

Lowering temperature slows the growth rate and results in more undersized carrots; a rise in temperature has the opposite effect. The size variables used were the average high temperature of the previous week (t-1) and the average high temperature of the week prior to that (t-2) (9). Temperatures used were the daily maximums recorded at Weslaco, Tex. Weather Station Weslaco 2E was centrally located and considered representative of the Lower Rio Grande Valley.

The quality variable used was the deviation from normal rainfall during the September planting period. The choice of rainfall variable was influenced by the distribution of rain during the growing season. Carrots are grown under irrigation for the most part, since rainfall in the Valley averages only 1.1 to 1.6 inches from November through March (9). Minor amounts of rain late in the growing cycle can easily be compensated for by halting irrigation briefly. The crucial period in carrot production, however, is in late summer and early fall when carrots are planted. Rainfall generally averages 4.2 inches in September and 2.6 inches in October and is characterized by wind and heavy downpours. This type of rainfall can influence both the quality and quantity of the crop by thinning the stand and introducing blight and other diseases. A thin stand not only lowers yield but may cause odd-shaped carrots to develop because the plants are grown too far apart. This was the situation in the fall of 1967 when serious flooding from Hurricane Beulah delayed normal plantings in the Lower Valley and washed out fields that had already been seeded.

13/ See the appendix for a discussion of adjustments in Market News data.

The relationship between f.o.b. shipping-point carrot prices in the Lower Rio Grande Valley and the quantity of carrots available was estimated for the 39 weeks comprising the winters of 1966, 1967, and 1968. Results were:

$$Y_{Cj} = 12.76 - \underset{(0.0027)}{0.0063^{*}} X_{CTj} = \underset{(0.0021)}{0.0107^{**}} X_{CCAj} + \underset{(0.018)}{0.172^{**}} R_j - \underset{(0.016)}{0.047^{**}} T_{j-1}$$

$$- \underset{(0.015)}{0.039^{*}} T_{j-2} \qquad D.W. = 0.95 \qquad R^2 = 0.88$$

where

Y_{Cj} = the f.o.b. price of Lower Rio Grande Valley carrots, 48-1's mesh, in week j;

X_{CTj} = total carlots of carrots shipped from Texas in week j;

X_{CCAj} = total carlots of carrots shipped from California and Arizona in week j;

R_j = deviation from normal Lower Rio Grande Valley rainfall for Division 10 14/ the previous September = -0.34 inches in September 1965 for winter 1966; -3.18 inches in September 1966 for winter 1967; and 14.07 inches in September 1967 for winter 1968;

T_{j-1}, T_{j-2} = average high temperature at Weslaco, Tex., weather station 2E, j-1 = previous week, j-2 = week 2 weeks previous; and

j = weeks 1-39 with 1-13 = winter 1966; 14-26 = winter 1967; and 27-39 = winter 1968.

Standard errors are shown in parentheses. One asterisk represents statistical significance at the 5-percent level; two asterisks, significance at the 1-percent level.

The results of the regression equation indicate that Texas quantity, California quantity, and rainfall and temperature variables were all significantly related to the Lower Rio Grande Valley's f.o.b. shipping-point price of winter carrots. The estimated relationship implies that a 100-carlot increase in Texas quantity would be expected to decrease shipping-point price 63 cents and that a 100-carlot increase in California shipments would decrease Texas price $1.07.

Deviations from normal September rainfall in Division 10 were significantly related to Texas carrot prices. Since excessive rainfall apparently creates disease problems and thins stands of newly planted carrots, as noted above, the average price of Texas carrots would be expected to increase 17 cents for every inch of rain above normal based on the regression analysis.

14/ Division 10 is the designation given 13 U.S. Weather Bureau observation points in the Lower Rio Grande Valley of Texas.

The temperature variables used were significant in the estimating equation: a 1-degree rise in the previous week's average high temperature would be expected to lower current carrot prices 4.7 cents; a 1-degree rise in the average high temperature for the week 2 weeks earlier would be associated with a 3.9-cent decrease in the current week's price. Since high temperatures speed growth, a higher proportion of the crop are medium-large carrots, the size generally packed in film bags.

The equation explained 88 percent of the variation in Lower Rio Grande Valley carrot prices. In general, Texas carrot prices in the short run were a function of quantity. However, account must be taken of whether the carrots originate in Texas or California, and the probable quality and size distribution of the weekly crop.

The predicted price for 48-1's mesh in Texas was $4.03, using mean values for the independent variables in the regression equation. The corresponding direct price flexibility was -0.25 which was relatively low, compared with expectations, but consistent with the significant coefficients associated with temperature and rainfall variables used as proxy variables for quality and size of Texas carrots. These variables were correlated with the quantity of Texas shipments, and it was hypothesized they were even more strongly correlated with the quantity of medium-large carrots of good quality and condition. In effect, temperature and rainfall variables may have been better indicators of the quantity of Texas carrots of good quality and condition than were the data on available shipments, which were incomplete (app. table 1). It was expected the cross price flexibility between Texas prices and California-Arizona shipments would be negative, indicating substitutes. The estimated cross price flexibility based on the regression equation was -0.57, which appears reasonable. A 1-percent increase in California-Arizona shipments would decrease Texas price by -0.6 percent at the mean, indicating a substitution effect. This is also consistent with the high (0.9) correlation between carrot prices in Texas and California-Arizona. With a decrease in Texas shipments, prices in both Texas and California would then increase, indicating a substitution effect between the two areas.

Further improvement in the estimating equation can be made by introducing a dummy or shift variable for the 1966 winter season when a market order for Texas carrots was in effect. Results were:

$$Y_{Cj} = \underset{}{12.16} - \underset{(0.0023)}{0.0062^{*}} X_{CTj} - \underset{(0.0021)}{0.0142^{**}} X_{CCAj} + \underset{(0.018)}{0.203^{**}} R_{j} - \underset{(0.014)}{0.040^{**}} T_{j-1}$$

$$- \underset{(0.013)}{0.030^{*}} T_{j-2} + \underset{(0.237)}{0.847^{**}} D_{66} \quad D.W. = 1.35 \quad R^{2} = 0.91$$

where variables are as defined above and D = dummy variable for winter 1966. D = 1 for 1966, 0 for 1967 and 1968. The equation indicates that temporary conditions (possibly the market order) raised prices in the winter of 1966 85 cents above the level of prices in the winters of 1967 and 1968.

Shafer (6), in an extensive study, analyzed prices of Texas carrots on a yearly, monthly, and weekly basis for a number of years. For the 1956 through 1968 winter seasons (December-May), he explained from 14 to 94 percent of the

variation in weekly Texas carrot prices each year using Texas shipments, California rail shipments, California truck shipments, on-track holdings in 16 terminal markets, and per capita income.

Shortrun prices for Texas winter carrots were influenced by the quantity of shipments from both Texas and California. Climatic variables improved price estimates since total shipment data did not take into account differences in the distribution of quality and size of Texas carrots.

The estimating equation can be used to predict Texas f.o.b. price. For example, if Texas shipments in the current week X_{CTj} total 150 carlots; California-Arizona shipments X_{CCAj} total 220 carlots; R_j is 2.2 inches; T_{j-1} is 69 degrees; and T_{j-2} is 73 degrees, the predicted Texas price of 48-1's mesh, Y_{Cj}, for a particular week, would be $3.75. 15/

It was concluded, therefore, that variations in shipping-point prices of Texas carrots were related to the quantity of produce available as expected in a competitive market. However, the question remains whether the level of observed shipping-point prices is consistent with competitive prices. Carrot prices in Texas dropped to $2.07, $2.00, and $2.04 per 48-1's mesh during February and March 1967 and averaged only $2.25 for the entire 13-week period (table 3). This is close to the estimated level of packing and harvesting costs--$1.70-$1.75 per mesh sack. Theoretically, if shippers had monopoly power, they would withhold supplies from the market rather than let prices fall to the level of packing and harvesting costs. During the three winter seasons studied, there was no economic abandonment of carrots. Thus, there is some evidence that in the winter season of 1967 carrot prices were near the lowest level possible with a competitive market. Over the 3-year period, no general conclusion could be drawn regarding the competitiveness of the level of shipping-point prices in the Lower Rio Grande Valley of Texas. However, over the three winter seasons, the marketing system for fresh winter carrots performed well in transmitting price changes from the shipping point to the wholesale terminal market level.

15/ $Y_{Cj} = 12.76 - 0.0063(150) - 0.0107(220) + 0.172(2.2) - 0.047(69) - 0.039(73) = \$3.75$.

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APPENDIX

Several adjustments in the quantity data for carrots were necessary to insure comparability over the three winter seasons of January-March 1966-68 (app. table 1). In April 1967, the Market News Service changed its method of collecting data on California truck shipments. Previously, truck shipments were counted at State border stations. Hence, truck shipments represented only interstate shipments. Intrastate shipments could be approximated somewhat incompletely by taking California unloads data for the San Francisco and Los Angeles consuming-center markets. After April 16, 1967, truck shipments were obtained from shipping-point areas and represented both interstate and intrastate movements. For purposes of this analysis, data for California truck shipments for the 1966 and 1967 winter seasons were adjusted by adding in carrot unloads for Los Angeles and San Francisco originating in California. To the extent these data excluded intrastate shipments to markets other than Los Angeles and San Francisco, 1966 and 1967 winter truck shipments for California were underestimated.

Data on shipments of winter carrots were available for both rail and truck for the Lower Rio Grande Valley of Texas. Rail shipments only were reported for other areas within the State, including Winter Garden, Laredo, and the Hereford area of northern Texas. Truck shipments were based on available data for the 1966 and 1967 winter seasons; no attempt was made to estimate total truck shipments for the State.

In the fall of 1967 prior to the 1968 winter season, Hurricane Beulah inflicted extensive damage on the Lower Valley carrot crop. Serious flooding delayed normal fall plantings and acreages already in carrots were washed out. However, in areas farther from the Valley, damage from Beulah was not as severe and growers could expand their winter carrot marketings.

During the first 10 weeks of the 1968 winter season, unloads of Texas carrots in 41 cities were consistently greater than reported shipments of Texas carrots. This indicates heavy truck volume out of the State but not out of the Lower Valley. To obtain a more accurate measure of Texas volume, data on unloads rather than on shipments were utilized for most of the 1968 winter season. The Lower Valley resumed more normal production in March and for the last 3 weeks of the season, data on shipments were used. Thus, it was determined the 1967 and 1968 Texas crops were roughly 90 percent and 70 percent, respectively, of the 1966 crop.

To arrive at supplies of winter carrots from areas other than California and Texas, data on shipments for those States reporting both rail and truck were added to data on unloads for those areas where information on shipments was nonexistent or incomplete. Imports from Canada and other countries were also included.

Appendix table 1.--Rail, truck, and total shipments or unloads of carrots from Texas, California, Arizona, Florida, other States, imports and totals for the United States, by weeks, January, February, March 1966-68

Year and week ending--	Texas			California				Total shipments, Arizona	Total unloads, Florida	Unloads, other States 4/	Total imports 5/	Total, United States
	Shipments			Shipments		LA and SF unloads 3/	Total					
	Rail	Truck 1/	Total	Rail	Truck 2/							
	Carlots											
1966:												
January 8	108	59	167	70	33	79	182	22	4	9	13	397
15	129	53	182	108	37	93	238	34	7	7	11	479
22	51	27	78	106	49	107	262	30	4	5	6	385
29	46	24	70	142	53	106	301	38	6	5	7	427
February 5	98	64	162	107	38	90	235	36	8	4	1	446
12	136	78	214	80	38	103	221	20	8	-	2	465
19	113	66	179	112	38	106	256	18	7	3	1	464
26	60	54	114	75	42	88	205	35	5	2	-	361
March 5	116	76	192	105	41	94	240	25	12	1	-	470
12	139	80	219	90	47	98	235	41	9	2	-	506
19	101	92	193	93	41	99	233	44	8	-	-	478
26	123	77	200	79	42	110	231	53	9	3	-	496
April 2	140	83	223	88	42	90	220	51	12	-	-	506
Total, winter 1966	1360	833	2193	1255	541	1263	3059	447	99	41	41	5880
Average, winter 1966	105	64	169	97	42	97	235	34	8	4	6	452
1967:												
January 7	74	58	132	44	28	75	147	13	10	9	10	321
14	48	57	105	76	34	101	211	30	18	7	13	384
21	87	75	162	60	41	92	193	43	16	15	9	438
28	113	74	187	51	35	88	174	25	20	8	7	421
February 4	104	101	205	46	37	91	174	23	16	7	5	430
11	100	90	190	47	30	88	165	27	24	6	-	412
18	143	90	233	56	31	88	175	26	15	3	4	456
25	120	99	219	45	39	85	169	18	20	-	1	427

Continued--

Appendix table 1.--Rail, truck, and total shipments or unloads of carrots from Texas, California, Arizona, Florida, other States, imports and totals for the United States, by weeks, January, February, March 1966-68--Continued

Year and week ending--	Texas Shipments			California Shipments		LA and SF unloads 3/	Total	Total shipments, Arizona	Total unloads, Florida	Unloads, other States 4/	Total imports 5/	Total, United States
	Rail	Truck 1/	Total	Rail	Truck 2/							
	Carlots											
March 4	83	91	174	55	35	86	176	23	18	1	2	394
11	120	97	217	57	35	82	174	29	14	1	2	437
18	126	89	215	57	37	107	201	35	23	-	1	475
25	99	63	162	48	34	82	164	27	19	-	-	372
April 1	106	74	180	55	36	86	177	11	16	-	-	384
Total, winter 1967	1323	1058	2381	697	452	1151	2300	330	229	57	54	5351
Average, winter 1967	102	81	183	54	35	89	177	25	18	5	5	412
1968:												
January 6	40	2	6/79	33	129	---	162	13	12	5	20	291
13	25	0	6/103	46	140	---	186	25	17	13	41	385
20	65	22	6/121	54	153	---	207	31	19	8	35	421
27	26	28	6/131	44	142	---	186	26	17	5	23	388
February 3	41	19	6/99	47	130	---	177	16	18	5	9	324
10	37	38	6/108	48	131	---	179	28	14	4	8	341
17	34	27	6/105	76	156	---	232	16	18	3	16	390
24	31	20	6/77	92	162	---	254	43	19	3	27	423
March 2	54	30	6/107	112	171	---	283	51	31	-	23	495
9	38	37	6/91	108	172	---	280	63	20	2	11	467
16	79	82	161	123	189	---	312	46	22	4	2	547
23	98	88	186	109	201	---	310	48	17	1	-	562
30	86	123	209	115	156	---	271	36	16	2	-	534
Total, winter 1968	654	516	1577	1007	2032		3039	442	240	55	215	5568
Average, winter 1968	50	40	121	77	156	---	234	34	18	5	20	428
Average, three winters	86	62	158	76	---	---	215	31	15	4	8	431

1/ Lower Rio Grande Valley only.
2/ Interstate only, 1966 and 1967.
3/ LA = Los Angeles; SF = San Francisco.
4/ Colorado, Massachusetts, Michigan, New Mexico, New York, Oregon, Washington, and unknown.
5/ Canada.
6/ Texas unloads.

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